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WHEN DO STATES DISRUPT INDUSTRIES? ELECTRIC CARS IN GERMANY AND THE UNITED STATES

國家何時干預產業？以德國與美國的電動汽車為例

MIT CEEPR
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The 2008 financial crisis has led to a renaissance of industrial policy in economies around the world (Stiglitz, Lin et al. 2013). Many of these sectoral policy interventions have focused on clean energy technologies—such as solar, wind, and energy storage—in an attempt to stimulate economic growth, while mitigating climate change (Aggarwal and Evenett 2012, Rodrik 2014, Zysman and Huberty 2014). However, the extent to which governments have intervened

本期摘要(KEY INFORMATION)

◎2008 年金融風暴過後，許多國家政策干預措施側重於潔淨能源技術，以刺激經濟成長並緩和氣候變化。為推動環境技術變革，各國對成熟產業的干預程度大不相同，以德國和美國開發電動汽車市場為例，美國智庫 CEEPR 的研究結果顯示，德國未能全面實施綠色工業政策為電動汽車提供適度的研發支援，其受制於現有汽車製造商，傾向保護現有技術，並防止環境團體和綠色技術挑戰者的政治影響；反之美國在汽車產業全面實施綠色工業政策，激勵電動汽車的製造和商業化，並強化排放管制來帶動電動汽車的需求。美國採取破壞性的綠色創新政策，積極支持汽車大廠改造潔淨技術。另一方面，集團主義國家的政府可能與企業協調出合乎現有利益的長期技術願景，對技術發展的支持政策穩定，但可能導致政策變動受限與管制俘獲(regulatory capture)，而多元主義國家則傾向制定破壞性的政策，這可能犧牲長期的穩定支持，在技術軌跡方面，與各界的協調也面臨更大的障礙。

◎為提升中國快速發展工業部門的能源效率，中國在「十一五」（2006-2010 年）期間啟動了全國 1000 大耗能企業計畫（T1000P），這項計畫鎖定約 1000 家全國能源需求最高的企業，亦即在 2004 年至少消耗 18 萬噸煤炭的企業，其中又以高耗能的鋼鐵工業為主。美國智庫 CEEPR 研究了 T1000P 對於該計畫中鋼鐵工業的全要素生產率(TFP)所造成的影響，而 TFP 對企業維持國際競爭力及高度長期成長率至關重要。過去的文獻認為企業生產力會遭受環境法規的負面影響，但對於 T1000P 計畫在中國造成的影響，CEEPR 的研究結果卻相反，法規對於受管制企業的 TFP 產生了正面的影響，CEEPR 認為原因是參與 T1000P 的企業可獲得補貼，提高其設施的效率，將大量遵循成本轉移給國家，該政策可能讓公司將精力集中在可輕易達成的目標，這些與節能相關的目標有利於營運效率及降低成本。

in mature industries to drive environmental technological change has varied considerably across countries and sectors. For instance, both Germany and the United States have major auto sectors that produce fuel-intensive cars. Vehicle transportation emissions in both economies make up nearly one fifth of greenhouse gas emissions. The two countries adopted ambitious targets to develop lead markets for electric cars. Yet despite a far more developed industrial policy apparatus, Germany fell short of its ambitions, while the United States adopted a disruptive set of industrial and regulatory policies to promote the manufacturing and commercialization of electric cars (Lane, Messer-Betts et al. 2013). When do states adopt disruptive innovation and industrial policy?

Literatures on the state and industrial change point to variations in institutions to explain the different abilities of governments to promote industrial development through sectoral intervention. Centralized bureaucracies helped industrializing East Asian countries to catch up with the technological capabilities of advanced economies (Wade 1990, Evans 1995). Peripheral state agencies have allowed industrialized countries to develop new high-technology sectors (Breznitz and Ornston 2013). This article instead argues that—in mature industries—patterns of interest intermediation determine when governments use green industrial policy to drive technological change. In what we call corporatist developmental states, industry and government coordinate technological transformations in consensus-driven negotiations. Such coordination inherently prioritizes the interests of incumbent firms that benefit from the existing technological regime, ultimately limiting disruptive state intervention. In pluralist developmental states, by contrast, competition among interest groups allows policymakers to organize coalitions of technology challengers and environmental interests in support of their technological preference, instead of being locked into stable negotiations with incumbent firms. This can result in strong sectoral state intervention to facilitate disruptive technological change through green industrial policy.

We examine our argument in the context of electric vehicle policy in Germany and the United States between 2000 and 2013. Our findings indicate that Germany failed to implement a comprehensive green industrial policy to support its electrification goals. Providing modest R&D support for electric cars, Germany's green industrial policy efforts were stalled by incumbent carmakers who sought protection of existing technologies. This is the result of a high degree of coordination between the federal government and domestic auto producers—VW, Daimler, and BMW—focused on continuing sales in diesel cars, while preparing for a long-term future in electric cars. A high degree of coordination prioritized incumbent interests while preventing political influence of environmental groups and green technology challengers. Counter to conventional expectations, the United States implemented a comprehensive set of green industrial policies in the auto sector, incentivizing the manufacturing and commercialization of electric cars while

tightening emissions regulation to drive demand for electric cars. Such disruptive green innovation policy was made possible by political competition among fluid coalitions made up of parts of industry, environmental groups, and security interests concerned with oil dependence. U.S. policymakers did not respond to incumbent demands, but actively organized coalitions to support the technological re-direction of the Big Three auto firms—GM, Ford, and Chrysler—toward cleaner technologies.

Our findings point to a trade-off between policy stability and policy disruption in innovation policy-making. Corporatist states are likely to be able to coordinate incumbent actors around long-term technology and policy visions that are compatible with incumbent interests. This tends to result in high policy stability of government support for technology development. It also suggests that corporatist states may have greater capacity to address coordination challenges that exist within technological trajectories. These are particularly prevalent in network industries such as electricity and transport. The ideal-type is Japan, where firms and government coordinate around the long-term vision of hydrogen fuel cells as the technological future of the transport sector. Policy stability, however, comes at the expense of limited policy change and the risk of regulatory capture. Pluralist states, instead, tend to develop more disruptive policy, likely at the expense of long-term stable support. For instance, U.S. tax incentives for solar photovoltaics and wind have fluctuated significantly over time, depending on political support coalitions. Due to low barriers of entry for new groups and multiple policy fora, pluralist states may also face greater obstacles in coordinating multiple actors within technological trajectories. As states increasingly intervene in mature industries to promote clean energy transformations, their comparative political advantages in implementing industrial and innovation policy may feature ever more centrally.

註：本文最末段的「regulatory capture」(管制俘獲)，被視為一種政府的失敗經驗，意指基於公眾利益施行管制的機構，遭被管制企業實質支配控制的現象。當管制俘獲發生時，企業或政治團體的利益優先於公眾利益，將導致整體社會的淨損失。(參照維基百科)

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A GREEN BARGAIN? IMPACTS OF AN ENERGY SAVING PROGRAM ON CHINA'S IRON AND STEEL INDUSTRY

綠色交易？節能計畫對中國鋼鐵工業的影響

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To improve the energy efficiency of China's rapidly-growing industrial sector, China's central government launched the national Top-1000

Energy-Consuming Enterprises Program (T1000P) during the Eleventh Five-Year Plan (FYP) (2006-2010). At that time, the T1000P was the most ambitious effort ever made in China in terms of its coverage of energy-intensive firms and state resources allocated to reduce industrial energy use. It was designed to support a national goal of reducing energy intensity by 20 percent nationwide during the Eleventh FYP. The program targeted about 1000 of the country's most energy demanding firms, i.e. the firms consuming a minimum of 180,000 tons of coal equivalent in 2004 (Price, Wang et al., 2010). Due to its high energy consumption, the highest share of firms targeted by this regulation belonged to the iron and steel industry.

In this paper, we study the impact of the T1000P on the total factor productivity (TFP) growth of iron and steel firms included in the program. TFP growth is a measure of the efficiency with which firms turn inputs into outputs. It is critical for maintaining international competitiveness and sustaining high long-term growth rates. Finally, it represents a foundation of social welfare and living standards (Greenstone, List et al., 2012; Krugman, 1997).

Previous literature has found that firm productivity is adversely affected by environment regulations (Gollop and Roberts, 1983; Gray and Shadbegian, 2003; Greenstone, List et al., 2012). We measure the impact of the program in China and find the opposite: that firms included in the program experienced greater productivity growth that those not included. The benchmark specification finds the regulation positively affected TFP change in treated firms by 3.1 percent on average between 2006 and 2008. Technical change and scale efficiency change contributed about equally to this overall effect. Observed positive effects are robust to alternative methods of constructing a comparison group, and instrumenting for selection into the program. The average economic benefit of the program to each treated firm is estimated to be 148.7 million Chinese renminbi in 1998 values, before accounting for the economic value of any improvements in environmental integrity.

The positive effect of the policy on productivity growth is noteworthy as it differs from findings of negative effects in prior studies of developed countries. We suggest at least two reasons for this finding. First, firms involved in the T1000P were able to access subsides to improve the efficiency of their facilities, transfering a large share of compliance costs to the state. Second, the policy may have focused firm energy and effort on low hanging fruits related to energy saving that delivered benefits in the form of operational efficiencies and reduced costs.

Several features of this study stand out. First, it is one of only a few studies to estimate TFP change using a cost function approach. Second, to our knowledge, this is the first study of its kind for China. Third, our specification enables us to distinguish between the subcomponents of technical change and scale efficiency change using parametric methods. Such decomposition allows for a more detailed analysis of the effects of the regulation than what has been common practice in the literature. Fourth, we include

muliple robustness checks to address concerns about selection bias and time-varying potentially cofounding factors. Fifth, the study uses a uniquely detailed firm-level data set. Detailed information from the Chinese Industrial Census was used to construct an unbalanced panel of 20,076 unique observations of 5,340 firms over the period 2003 to 2008. Effects of the T1000P on TFP change are analyzed by applying a difference-in-difference research design.

Our results are robust to alternative empirical strategies. We control for temporal, spatial, sub-industry and firm-specific heterogeneity when assessing the impact of the regulation on productivity. Results are robust when stratifying the sample along several dimensions, when accounting for sample attrition, when instrumenting for T1000P exposure and when accounting for a potentially confounding regulation that required closure of certain small, inefficient iron and steel producers over the same period.

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